Application Note **PRD-08407**

LM MODULE PLATFORM MOUNTING GUIDE

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The secure mounting of a module on a lead frame determines the reliability and thermo-mechanical life of the housing. Optimal mounting ensures maximum thermal conductivity, in turn facilitating desirable power device junction temperatures. On a system level, stable mounting of power modules ensures better structural rigidity and consequently, better mechanical reliability over the product lifetime.

This document provides guidance on how to install or mount the Wolfspeed® LM power modules to a cold plate and how to design and construct the mechanical system in which the module will be placed. This guide is applicable to all Wolfspeed products having the LM module footprint, including all part numbers with an 'LM' in the last three characters of the part number (e.g., CAB600M33LM3).

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CAUTION

Before operating the system, please carefully review the operating limits for the relevant Wolfspeed LM™ power module set forth in the datasheet located at www.wolfspeed.com or available upon request, and please ensure that appropriate safety procedures are followed when working with the system. There can be very high voltages present in the system when connected to an electrical source (and thereafter until applicable capacitors are fully discharge), and some components in the system can reach very high temperatures. Serious injury, including death by electrocution or serious injury by electrical shock or electrical burns, can occur if you do not operate the module within its operating limits or follow proper safety precautions.

1. Introduction

This document provides guidance on how to properly mount Wolfspeed® LM power modules (hereafter referred to as 'modules') and design a system that maximizes its performance and reliability. When mounted, the module must be securely held in place, while not exceeding the baseplate mounting hole and power terminal force ratings. Similarly, the module's gate driver should be firmly attached to a rigid surface to ensure that it remains in place, while not placing excessive force on the signal pins of the power module it is attached to. Furthermore, the bussing attached to the power module must not induce excessive stress on the module's power terminals. Following the guidance described in this document is recommended to ensure proper mechanical mounting of the LM power module.

2. Cold Plate Mounting Procedure

Align the mounting holes carefully and place the module onto the heatsink or cold plate taking care not to slide the module. Install the washers and thread in the M6 bolts until seated finger tight. Following Figure 4 and using a torque wrench, tighten the bolts in the sequence described below until the desired torque is reached. The recommended torque is 4.5 N-m. It is recommended to inspect the bolt and screw torques after the module has been subjected to thermal and power cycling.

1. Torque bolt number: 1 – 2 – 3– 4 to 1/3 final torque
2. Torque bolt number: 3 – 4 – 2 – 1 to 2/3 final torque
3. Torque bolt number: 2 – 1 – 3 – 4 to final torque

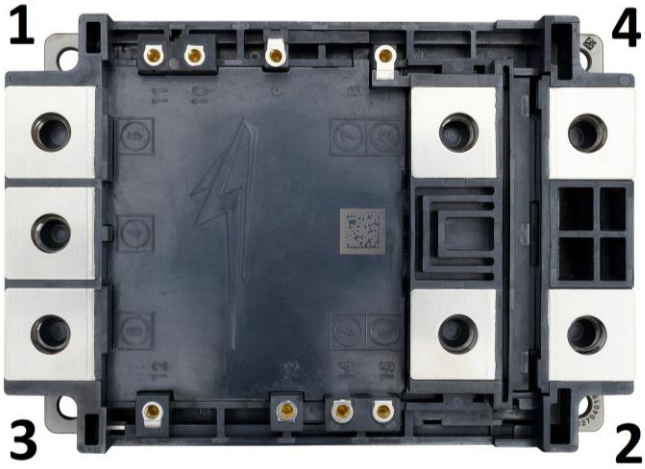

Figure 1: LM Module bolt pattern reference

3. Power Terminal Mounting

The power terminals of the LM are designed for DIN M8 bolts (class 6.8 minimum) tightened with a torque not exceeding the maximum of 16 N-m. The engagement depth of the screw into the power terminals must not exceed the maximum penetration depth of 15 mm, which is found in the LM Module datasheet located at www.wolfspeed.com or available upon request and depicted below. Exceeding this value may result in significant damage to the power module.

It is imperative that the bussing connected to the power terminals of the module does not place excessive force on the power terminals. This condition must be maintained even under shock and vibration conditions. Consequently the bussing must have proper mechanical stress relief, which will serve as a rigid mechanical connection between the module baseplate and bussing, minimizing the amount of force that may be placed on the power terminals because of an outside force being placed on the bussing.

The power terminals of the LM module are threaded for M8 bolts. As such, the mounting hole in the bussing that is attached to the module should be as close to the standard M8 clearance hole of 4.5 mm radius as possible, given the tolerances in your system. Excessively exceeding the standard M8 clearance hole size may result in damage to the power terminals of the module.

4. Gate Driver Mounting

The gate driver is mounted to the module's signal terminals using M3 screws. A demonstration of the gate driver board mounting over the module is shown below with a CGD3300HB6P-LM gate driver board. Like the power terminals, the signal terminals of the power module must also be protected from excessive force.

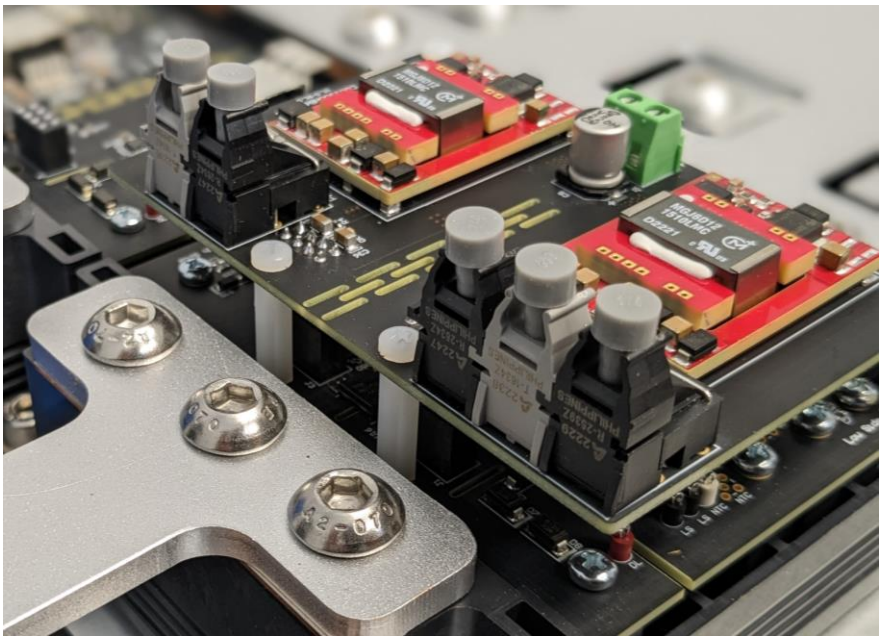

Figure 2: Gate Driver board mounting example

5. Provisions for System Vibration

The system's failure modes can be directly related to vibration, particularly random stresses like high acceleration levels, high stress levels and large displacement levels. For any new system design that mitigates the effects of the vibration, it is critical to review the vibration environment.

While random vibration can be shown to be made up of sinusoidal vibrations within the testing band, the effect of random vibration is not the same as a sweep of the frequency band because the frequencies are all active at the same time.

5.1 Mounting the Module to the Cold Plate

The details for the mounting torque procedure and values are mentioned in Section 2. A threaded fastener system depends on friction to precent it from coming apart, with the friction imparted by tension in the bolt (essentially acting as a very stiff spring). Under all circumstances this bolted interface must be under tension. While other solutions are available for special cases, including lock washers, fixing compounds, or bolts with inserts, these should not be used instead of the above recommendation.

The module itself is a relatively stiff object and is tested against vibration as part of the qualification process. However, the interfaces to the module are all subject to the effect of vibration.

It is imperative that the vibration/excitation environment and effect on the baseplate/mounting system do not induce a force at the bolted interface that will overcome the torque induced force which can lead to the bolt loosening.

5.2 Attaching the Power Bus to the Power Terminals

The power terminals are made of thick Cu strip with a bolted interface. The terminal bend traps a threaded nut that allows the external power connector to be bolted firmly to the terminal. This external power connection can be a lug on the end of a cable but in most cases will be some form of laminated Cu sheets or even a thick Cu printed wiring board.

The trapped nut and the bolt are part of a threaded interface dependent on friction to prevent it from coming apart, with the friction imparted by tension in the bolt. A lock washer or special locking bolts can be used to ensure a good connection.

When the external power connection is bolted to the terminal it should not impart tension on the module. Instead, it should impart some compression against the cold plate and be designed so that vibration in the system does not ever impart tension on the interface. If this compression force alternates between compression and tension it may lead to fatigue failure.

The power interface structure needs to be analyzed across the vibration environment to ensure that it is not excited by that environment to overcome the compressive force on the terminals.

5.3 Signal Terminals

Signal terminals are designed to be used with M3 screws. A lock washer or special lock bolts are suggested to prevent the screws from loosening over time. The LM module pinout can be obtained from its Pinout Guide.

5.4 Mounting Torque Considerations

The module terminals must be connected within the permissible tolerances specified in Table 1. The mounting of busbars, cable sockets and/or circuit boards (PCBs) must be organized in a manner that avoids sustained effects on the static and dynamic tensile forces being exerted on the terminals. The following recommendations are made for a Cu busbar, bare or with appropriate lamination, and PCBs with FR4/Cu layers.

The torque values recommended in Table 1 are based on typical galvanized steel metric bolts. In case bolts of a different material are used for assembly, the torque value must be adjusted based on the respective material's friction coefficient.

Table 1: Recommended torque of mounting bolts for electrical connections

Terminal	Mounting Bolt	Max. Screw depth (mm)	Mounting Torque (Nm)	
			Min	Max
Power	M8 (Class 6.8 minimum)	15	8	16
Signal	M3 (Class 6.8 minimum)	5	0.5	1.3

Table 1 assumes a mounting scenario where a cable socket is connected to the module, and the applied torque on the bolt transfers fully to the nut which is embedded in the plastic housing. However, there may be mounting scenarios where a massive busbar or a circuit board is placed on the module terminals, thereby limiting the amount of applied torque from the bolt being transferred to the nut embedded in the housing plastic. In such a case, the torque value must be adjusted based on the thickness and flexibility of the mounted components to ensure a stable mounting without adverse lateral stress on the terminals.

When applying torque on a bolt to a power or signal terminal on the LM module, care must be taken to ensure that the sum of all loads applied on the bolt is within the yield point of the terminal Cu. Flexural elements such as massive busbars should be mounted with care while also ensuring a rigid connection to avoid X-Y plane stresses on the terminals, as shown in Fig. 3.

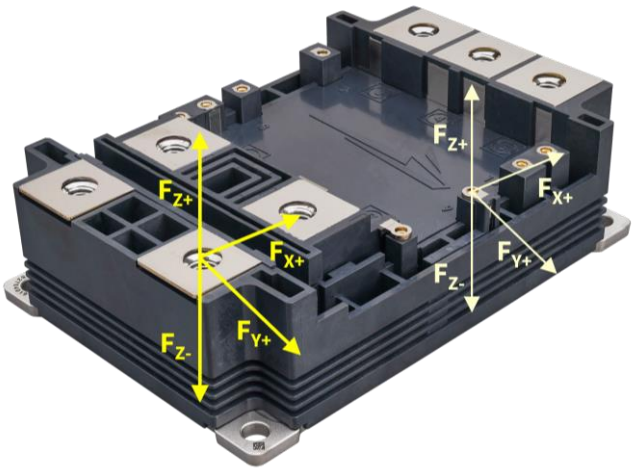

Figure 3: Visual representation of forces impacting the LM module

Table 2: Maximum permissible forces during module assembly for power and signal connections

Terminal	Mounting Force (N) X-Axis	Mounting Force (N) Y-Axis	Mounting Force (N) Z-Axis
Power	±100	±100	+100/-500
Signal	±100	±100	±100

It is recommended to have an assembly which leaves the power and signal terminals permanently free of mechanical stress. Since such an assembly is inherently problematic over the entire temperature range, the construction should be such that the power terminals as well as the signal terminals exhibit a load bias by means of suitable spacers.

It must be ensured that the direction of the bias force always acts in the direction of the base plate. The suitability of the support must be evaluated individually in the structure.

Static forces in other directions as well as exposure to vibration and/or thermal expansion should be avoided.

The signal terminals have to be connected accordingly, observing the common ESD guidelines. No load current is permitted to flow through the signal connector.

6. Conclusion

This application note provides guidelines for mounting bolts onto the terminals of Wolfspeed LM power modules. The recommended sequence for mounting and unmounting the baseplate on a cold plate is provided in Section 1, and the recommended procedure for mounting bolts on the power and gate terminals is illustrated in Sections 3 and 4. Considerations for mounting bus bars, gate drives, and cold plates on the various connection points of the LM module are given in Section 5, along with an overview of possible mechanical forces applicable on the various terminals.

Revision History

Date	Revision	Changes
March 2024	1.0	Initial Release
August 2025	2.0	Included new torque guidelines